






Moon Viewing Ideas for the Whole Family!

<http://observethemoonnight.org/>



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What is the International Observe the Moon Night?

The International Observe the Moon Night (InOMN) is a world-wide celebration of our nearest neighbor, the Moon! Each year in the fall, millions of people from hundreds of locations in countries across the globe come together to view the Moon and learn about its diverse roles in culture, history, science, and exploration.

The date and theme for InOMN (pronounced “eye-nom”) are determined by InOMN participants – like you. Visit the InOMN website to share your opinion about upcoming InOMN celebrations. On the website you can also share your InOMN events and stories, learn about events in your area, and find more resources.

<http://observethemoonnight.org/>

Join the celebration of the Moon!

Attend an event or host your own InOMN viewing!



An Invitation to Explore

You and your family are invited to explore Earth's closest companion, our Moon! The Moon is the brightest object in our sky, except for the Sun. It is the one object that *everyone* across our globe can see in the night (and sometimes day) sky!

In addition to the binoculars and tripod in this kit, you will find a selection of activity ideas, books, and suggested resources. All of these are intended to help you and your family explore the Moon together. The hands-on activities are designed specifically to be easy to do with materials that are easy to find, and are written with pointers and prompts to help adults engage children. A few ideas for family fun:

- Plan a family night sky viewing for the International Observe the Moon Night, complete with a nighttime picnic.
- Learn what's inside the Earth and Moon while getting messy in the kitchen making edible models.
- Read a bedtime story together about the Moon.
- Go to the library and search for stories about the Moon that reflect your family's cultural heritage.
- Encourage your family members to make up – and illustrate – their own stories about how the Moon or its features came to be.
- Use the recommended web resources to create your own online scavenger hunt for your children to learn more about the Moon in history, science, and culture.

Most important – have fun together while learning about and exploring Earth's nearest neighbor!



About Our Moon

A Quick Reference Guide To Help Adults Become Lunar Rock Stars

Why does our Moon shine?

Just like the planets, our Moon does not make its own light. It “shines” because it reflects the Sun's light. Our Moon is much closer to us than the Sun or other planets, so it appears much brighter to people on Earth. It is the brightest object in our night sky (when it is visible at night). Around the time of the full Moon, the Moon can help us to see at night!

How big is our Moon?

Our Moon is about 2,100 miles across (about 3500 kilometers). This is about the distance from New York City to Albuquerque, New Mexico!

How far away is our Moon?

Our Moon is just about 250,000 miles from Earth (about 380,000 kilometers). If our Earth were the size of a basketball, our Moon would be the size of a tennis ball. At that scale, they would be about 24 feet apart!



How old is our Moon?

Our Moon is about 4 and a half *billion* years old (that’s a lot of birthdays!). It is just a little bit younger than the Earth and the rest of the solar system.

How did our Moon form?

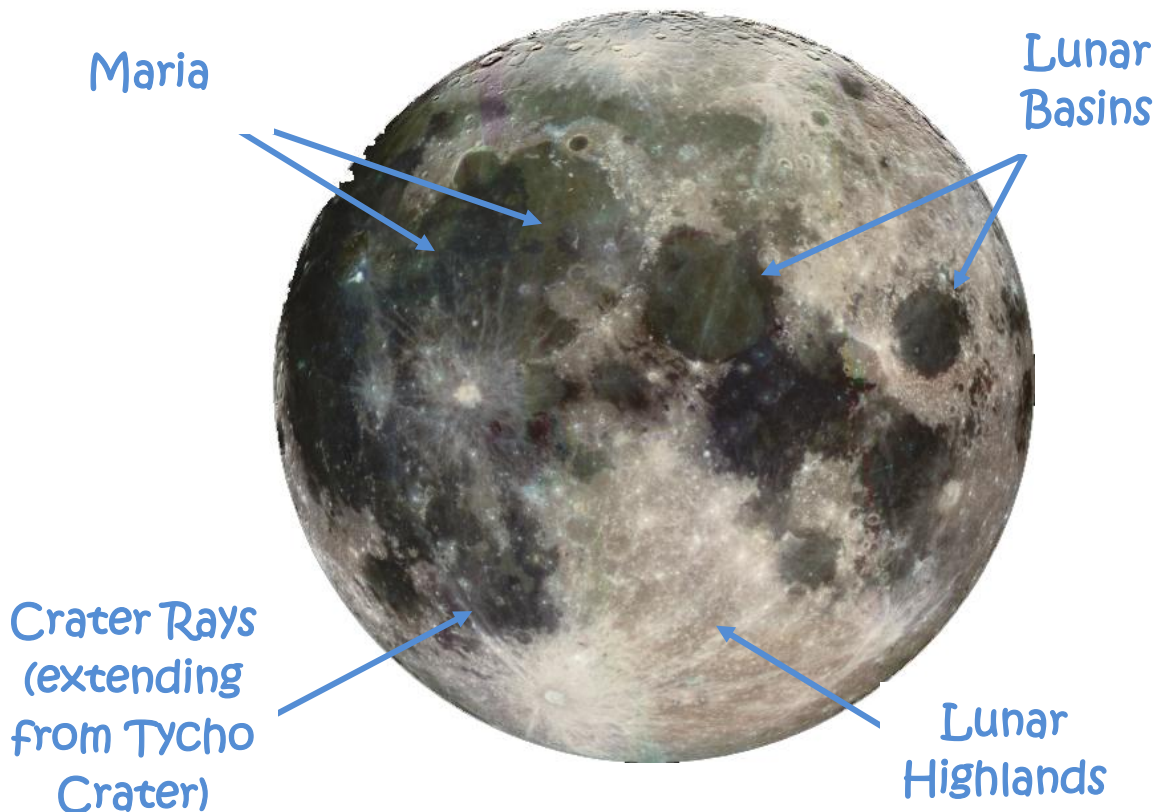
Using evidence from Moon rocks collected by the Apollo astronauts, and observations of our Moon’s orbit, scientists think that our Moon formed just after Earth formed. They think that a giant asteroid – about half the size of Earth – crashed into Earth. The asteroid broke apart. Some of it became a part of the Earth and some of it (and some of Earth, too) was knocked into orbit around Earth. Earth may have looked a little like Saturn does today – surrounded by a band or rings made of bits of debris. Eventually these rocky bits orbiting Earth clumped together, forming our Moon. This scientific hypothesis of our Moon’s formation, called “the Giant Impact Hypothesis,” best explains the scientific evidence at this time. As with all hypotheses, scientists studying the Moon will continue to gather and interpret scientific evidence and measure it against the

Giant Impact Hypothesis. Scientists may modify the hypothesis in the future based on new evidence. Science is a very exciting field – our understanding of our world, solar system, and universe gets refined as new discoveries are made!

What are the bright and dark areas on our Moon?

The lighter areas you see are called the Lunar Highlands. They are the oldest, roughest, most cratered part of the Moon. The rocks of the highlands formed when the Moon was young and hot (from all those bits slamming into each other to make the Moon). The Moon was so hot that at least part of it melted, forming an ocean of magma across the Moon's surface. This ocean cooled and solidified into the Moon's rocky crust. Rocks collected from the Lunar Highlands are between about 4 and 4 ½ billion years old!

The darker, circular areas you can see are called the Maria (pronounced “mar-ee-ah”). “Maria” is the Latin word for “seas;” these areas looked like seas to early astronomers. The circular basins formed when really big asteroids hit the Moon. Much later, after all the really big impacts had finished in our solar system, magma from deep inside the Moon made its way to the surface and flowed through cracks. The runny lava filled the low basins and cooled, forming a smooth dark rock surface in the big basins.



Why does the Moon have so many Craters and the Earth doesn't?

Over time, asteroids and comets have run into the Moon and the Earth, and everything in our solar system. But the Moon's surface has been very quiet for a long time. There are no more volcano eruptions on the Moon. The Moon does not have any atmosphere or flowing water – so there are no streams or wind to wear the craters down. Every object that hits the Moon leaves a crater that does not get erased. The astronaut's footprints from 35 years ago are still there!

Earth is very active. Wind and water and glaciers wear down the land – and any craters on it. (Earth also recycles its outer layer through plate tectonic activity; new crust is being created and old crust is being destroyed. Craters get erased very quickly on Earth).

What is inside of the Moon?

Cheese! No, not really! The Moon, like Earth, has three *main* layers, its inner core, middle mantle, and outer crust.

The Moon has a very small metallic core at its center that probably is mostly iron with a little nickel and sulfur. This is the **yellow** at the center of the picture. The core is about 300 miles across (500 kilometers). For many years, the evidence suggested that our small Moon had cooled completely and the inner core was solid. Recent evidence suggests the core may be molten still!



The mantle, the middle layer of the Moon, is a dense rocky layer. It is about 620 miles thick (1000 kilometers). The **orange** and **blue** layers in the picture are the mantle.

The crust is the outer layer of the Moon. This is the light **gray** layer in the picture. It is the lightest or least dense. The crust ranges from 38 miles (60 km) on the near side to 63 miles (100 km) on the far side. The uppermost part of the crust is made mostly of a single type of rock – anorthosite. This is the rock that makes up the old, bright, light-colored lunar highlands you can see when you look at the Moon.

The Moon, and other rocky planets and moons, have layers because at some point early in their formation, they melted or partially melted. The heavy materials – like iron and nickel – sank to the center, and the lighter materials –

like rock – “floated” to the surface. The crust of the Moon is made of the lightest or least dense materials.

Scientists are very interested in learning more about the interior of the Moon. By understanding the internal layers, they can better understand how the Moon – and other planets and moons in our solar system - formed.

Why do we only see one side of the Moon?

The Moon spins on its axis (just like Earth does). It also orbits Earth. It takes the same amount of time to spin on its axis as it does to go around Earth once. Because of this, we always see the same side of the Moon – the near side. We never see the far side (*not* the dark side!) of the Moon from Earth.

Why does the shape of the Moon change?

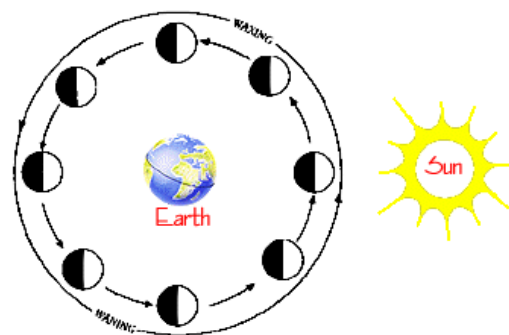
Actually, the shape of our Moon does not change ... it’s always a sphere! However, the shape of the part that is bright does appear to change! The “amount” of Moon that we see as we look from Earth changes in a cycle that repeats about once a month (29.5 days). The relative positions of our Sun, Earth, and Moon, cause these changes.

As our Moon orbits around Earth, the side facing the Sun is always illuminated, just like Earth's daylight side is illuminated by the Sun.

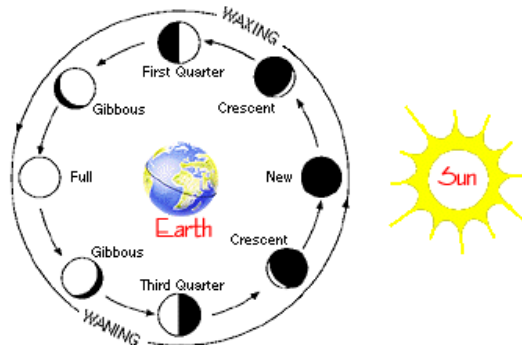
What we see *from Earth*, however, is a different story. Starting with the dark new Moon, we see the light part of the Moon “grow” from a sliver to a half to a full Moon — and then the illuminated part decreases, becoming thinner until there is no visible Moon in the sky and we are at the new Moon part of the cycle again.

We have a “new Moon” when our Moon's orbit around Earth moves it between Earth and the Sun. From Earth, the Moon's surface looks dark because the illuminated side is facing away from Earth. As our Moon continues its orbit counterclockwise around

Moon, Earth, Sun as viewed from above our Solar System



The Moon as seen from Earth



Images from

<http://starchild.gsfc.nasa.gov/docs/StarChild/questions/question3.html>

Earth (viewed from above the north pole), more and more of the illuminated part of the Moon becomes visible to us, until it reaches the “full Moon” stage. A full Moon occurs when the Moon has moved in its orbit so that Earth is “between” the Moon and the Sun.

Between the new and full Moon, the amount of Moon we see grows — or waxes from its right side toward its left side. As it passes the full Moon stage, the amount of illumination decreases — or wanes — from right to left. Finally, the Moon returns to its position between the Earth and the Sun, and on Earth we observe the new Moon again.

What would it be like to walk on the Moon?

Well, for starters, the Moon is smaller (has less mass) and therefore has less gravity than Earth. When you walk on the Moon, you are not “pulled back as hard” to the surface as when you walk on Earth. If you were on the Moon, you would weigh about $1/6^{\text{th}}$ of what you weigh now. In this reduced gravity you could jump higher and lift things that were too heavy for you on Earth. Perhaps the Moon will be the site of future Olympics?

You will need a spacesuit to provide water, air to breathe, and to maintain your temperature. The Moon has no atmosphere or *liquid* water. It is very hot when you are in the Sun and very cold when you are in the dark. Temperatures range from 225 F above zero down to 240 F *below* zero (105C to -150C)!

The Moon actually has water, hidden as ice in deep craters at the Moon’s poles. Because the Moon is not tilted on its axis, deep craters at its polar regions do not get exposed to incoming sunlight, and they stay cold. The ice may have been delivered by comets smashing into the Moon!

All of those comets and asteroid impacts have really broken up the lunar landscape! The surface of the Moon is covered with about two inches of very fine dust – in some places it is much deeper.

What if I don’t know the answer to a question that someone asks?

Oh no! You will lose your status in the Lunar Hall of Fame! Not really! Not having an answer is a great opportunity to enable the questioner to delve deeper. Just say you don’t know, and invite them to find out the answer online, in their library, or through another local expert. Shoot, you can even ask them to share the answer back with you! If it is a family member, this is a fantastic opportunity for you to research the answer together so that you can learn more together.

Family Moon Viewing

What You Need

- Binoculars
- Tripod for binoculars
- Moon Map / Viewing Guide such as the one provided or (<http://observethemoonnight.org/materials/>)
- Flashlight with its light covered by red film or tissue paper
- Blanket
- Folding chairs (optional)
- Picnic snack (optional)
- Drinking water (stay hydrated!)
- Bug repellent
- Books about the Moon (optional)
- Friends (optional)

What to Do Ahead of Time

Determine if you want a family-oriented event, or if you want to invite friends and their families.

Plan the Date and Time

Find out when the International Observe the Moon Night will be held (visit <http://observethemoonnight.org/>) and plan your viewing for that night. You might also want to look for local viewing events that may be held by your local astronomical society, planetarium, or museum.

Alternatively, pick a date on which the Moon will be high in the evening sky. Select a time when the Moon will be visible in the early evening sky using sources such as StarDate (<http://stardate.org/nightsky/moon>), the Planet Finder applet (<http://www.lightandmatter.com/planetfinder/en/>), or another planetarium program. The Moon is best viewed when it is a crescent or in first quarter, when the terrain casts longer shadows and the features become much easier to see. Note the times when the Moon will be visible – and high enough in the sky to see above any trees or buildings that may be around - to plan when you should arrive to view it.

You may want to observe other night sky objects as well. A more advanced tool sharing the month's constellations, deep-sky objects, planets, and events is available through Tonight's Sky (<http://tonightssky.com/MainPage.php>).

Pick the Location

Select a safe viewing location that is not brightly lit. One advantage of viewing the Moon is that it is very visible even with city lights – but if you can, pick a places that will minimize the amount of light that is around you. Be aware of water and insect hazards that may be located in the area.

Prepare to Wow Your Family With All of Your Knowledge

Pour your favorite beverage and peruse the “About Our Moon” guide to get up to speed on the Moon’s features and answers to questions from your family.

When viewing the night sky, it is important that your eyes adapt to the dark. Having bright, white light flashlights to find your way around, look at the Moon Map / Viewing Guide, or read a story keeps your eyes from adapting. The solution? Cover those flashlight(s) with red film or tissue paper! They will still help you navigate and read, but won’t disrupt your night vision.

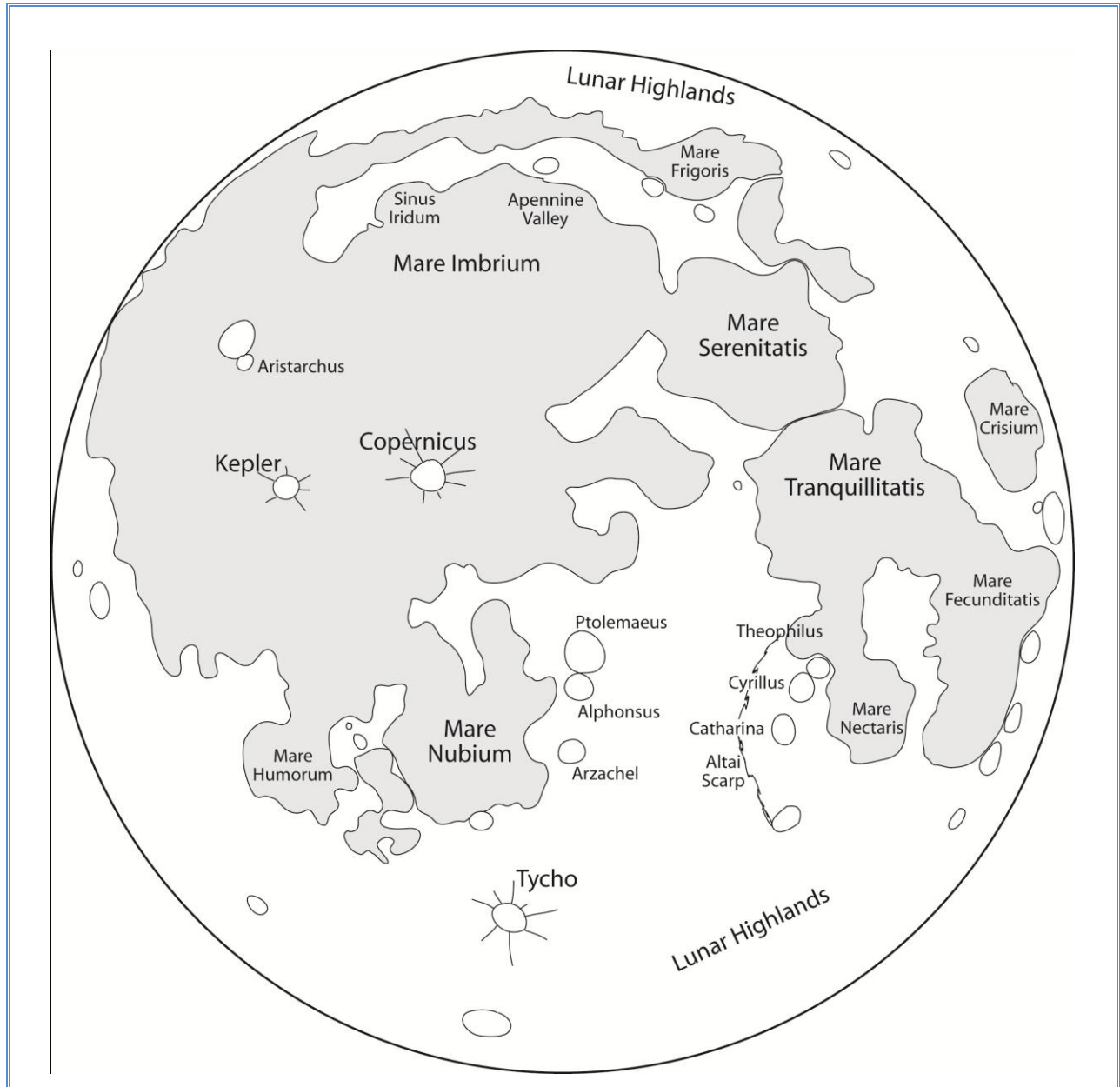
Binoculars are great viewing instruments for young astronomers. The two eye pieces often make observing easier, and objects viewed through binoculars appear upright and not inverted as they are by many telescopes. Binoculars will help you see some of the remarkable features of our Moon in vivid detail. Make sure the binoculars are adjusted to the viewer’s eyes. Most binoculars have a central focusing knob that moves both eyepieces at once as well as one eyepiece that can be focused individually. To work the binoculars, first use the central knob to focus the eyepiece that can't be individually adjusted, then focus the other eyepiece.

At every phase except full Moon, you will see the Moon’s face divided into a bright sunlit side and a shadow side. The line dividing these is the *terminator*. Features on the Moon - like the mountainous crater rims - stand out best at the terminator. As you move into the sunlit side away from the terminator, the landscape looks much smoother. The landscape near the terminator stands out because the Sun is near the lunar horizon. Like features on Earth at sunset, the features on the Moon cast long shadow that enhance the impression of height.

What to Do With Your Family


- On the viewing night, pack up your picnic and head to the viewing location!
- Once you are settled in place, start by looking at the Moon without the binoculars.
- Invite each family member to share one feature they can see. *Do they see the bright highlands? The large circular features that are darker?*
- Ask how they think these different features may have formed.
- Share the story about how the features formed.
- Questions may come up about the Moon to which you – or your family – do not know the answers (assign bonus points for such questions!). Keep track of these and help your family find the answers online or in the library later.
- Invite your family to take turns looking through the binoculars at the Moon's features.
- Invite your family to describe the features they see.
- Locate the features on the Moon Map / Viewing Guide.
- Break out the snacks and read a book about the Moon to your family!

Moon Map / Viewing Guide



Moon Map / Viewing Guide

A quick look at the Moon in the night sky – even without binoculars - shows light areas and dark areas. Can you find these features? Use the Moon map (above) to help!

Where you see  means that the feature is smaller and you will need binoculars or a telescope.

_____ I have seen it!	Sea of Tranquility (Mare Tranquilitatus) – Formed when a giant asteroid hit the Moon almost 4 billion years ago, this 500-mile wide dark, smooth, circular basin is the site of the Apollo 11 landing in 1969.
_____ I have seen it!	Sea of Rains (Mare Imbrium) – Imbrium Basin is the largest basin on the Moon that was formed by a giant asteroid almost 4 billion years ago.
 _____ I have seen it!	Appenine Mountains (Montes Apenninus) – Did you know there are <i>mountain ranges</i> on the Moon? The rims of the craters and basins rise high above the Moon’s surface. Apollo 15 astronauts worked in the shadow of Mons (Mount) Hadley, one of the peaks of the Montes Apenninus. Mons Hadley is over 2 and a half miles high!
 _____ I have seen it!	Copernicus Crater – A small, bright circle south of Imbrium Basin, with rays spreading up to 500 miles in all directions, marks Copernicus Crater.
_____ I have seen it!	Sea of Serenity (Mare Serenitatis) – Apollo 17 astronauts sampled some of the oldest rocks on the Moon from edges of the Sea of Serenity. These ancient rocks formed in the Moon’s magma ocean.
 _____ I have seen it!	Tycho Crater - A bright star of material stands out on the light-colored lunar highlands of the Moon’s southern half. This is Tycho Crater, a 50 mile wide crater with ejecta rays stretching over 1200 miles.
_____ I have seen it!	Lunar Highlands – The lighter areas on the Moon are the lunar highlands. These are the oldest regions on the Moon; they formed from the magma ocean. Because they are so old, they have been hit by impact craters many times, making the highlands very rough.

Throw an InOMN Viewing Party!

The following planning points are helpful for different types of InOMN events from small block parties to big planetarium bashes. These tips and more can be found on the InOMN website at <http://observethemoonnight.org/getInvolved/>.

Consider Your Audience and Setting

Participants:

- Who would you like to come to your event?
- How many people would you like to attend?
- Will this event be open to the public? Will you confine it to members of a neighborhood, club, or society? Members and their families?
- Will you involve school groups?



Location:

- Where will you host your event?
- Are there permissions and permits needed to use this desired venue?
- How many people will this venue hold? Will this size be sufficient to accommodate all of your desired participants?
- Is there easily accessible parking from which your participants can safely reach this venue, with enough parking spots for all of your expected participants?
- Does this venue have both an indoor and outdoor area? Would you like to use them both?
- Does your venue have access to restrooms?
- Will you be able to turn off enough outside lights so that they do not interfere with telescope viewing?
- Can you make sure there will not be any sprinklers watering the lawn, if you will be using a grassy area for observations?
- Does the outside need to be treated for bugs such as mosquitos or fire ants?
- What will you do in case of rain?

Dates and Times:

- Check out the InOMN website for the date (<http://observethemoonnight.org/>).
- Find sunset times and Moon phases for your area through <http://www.sunrisesunset.com/> or similar sources.

Get help!

- Who will be assisting you with the program?
- Are there amateur astronomers in your community? Could they bring telescopes, assist with viewing, and/or provide a speaker (if you choose to have one)?

- Are there any colleges in the area with astronomy departments or clubs? Would they be willing to help host your event?
- Will you have enough people to help you set up, run, and clean up after your event?
- Check out the Community Connections (<http://observethemoonnight.org/getInvolved/connections.shtml>) for links to find local astronomical societies or the Speakers Bureau.

Download InOMN Kits

Download an InOMN Kit (<http://www.lpi.usra.edu/observethemoonnight/materials/>), which has all of the materials you need to start preparing for your InOMN event.

Advertise!

Now that you've got all the plans made, it's time to attract your participants! Whatever your intended audience, materials to help you advertise can be found at <http://observethemoonnight.org/materials/>. These include Save-the-Date cards, and Site-Specific fliers in different formats.

Be sure to **register your event** on the InOMN site - Put your event and location details on the map!

Host - And Have Fun!!!

The main event! Make sure your participants, your volunteers — and you! — are (safely!) engaged, excited, and learning and sharing information about the Moon!

Evaluate!

We hope that all InOMN events will be resounding successes — and if they are, we would like to know about it! However, just as importantly, we'd also like to know if anything did not work out as you hoped it would, and what we could do to help you improve your future InOMN events. Please fill out a host's evaluation on the InOMN site to let us know how it went and how we can help.

In the host's evaluation, we will ask you to summarize the experience of your participants: What did they think was the most fun? The most informative? What would they change for next year? Knowing these answers can help you be an even better host the next time around — and help us to provide better materials, training, information, etc. in the coming years to help both you and your participants have even better experiences at future InOMN events.

Please encourage your attendees to fill out the participant's evaluation also provided on the InOMN site, at your event to ensure their voices and opinions are heard, and their suggestions considered.

Ideas for Ways to Engage Your Audience

Greet Your Audience

To welcome participants to your event, you can start with an introduction to the evening. Let people know what activities or talks will be happening throughout the evening, and where they will be located. This is a great time to review the locations of facilities and any safety procedures or precautions you'd like your participants to take, including how to safely and politely use telescopes throughout the evening. Another important topic to discuss is what people should expect to see on the Moon that evening: what sorts of features are visible with the naked eye? Will any features (such as those along the terminator) be specifically highlighted during telescope observations? It is also important to let people know the kinds of things they will not be able to see through a telescope, such as landing sites and LRO orbiting the Moon. This is your chance to set up reasonable expectations for your audience.

Depending on whether all of your participants are expected to arrive at once, or trickle in throughout the evening, you may want to repeat this talk later in the evening so that all guests get a chance to hear it.

Have Telescope Viewing Available

Whether you will be at an observatory, school, museum, field, or any other appropriate location, having one or more telescopes through which people can view the Moon would really enhance any InOMN event. The number of telescopes will of course depend on availability, but the more people you expect to attend, the more telescopes it would be nice to have. Local astronomy clubs are often well-versed in assisting with observing campaigns, and many members may have — and be willing to share — telescopes. Whether you, as the host, would like to coordinate the telescopes (as in, certain telescopes are looking at certain features on the Moon), or whether you would like to let telescope owners or operators select features to view is up to you. Coordinating to some degree may ensure more diverse viewing opportunities, for larger groups in particular.

If telescopes are not available, or if your event is in a location where telescopes would be hard to bring, binoculars are a great alternative.

Get Your Local Experts Involved – Have Them Give Public Lunar Talks

Another excellent way to enhance a InOMN event would be to introduce, or re-familiarize, attendees with the main attraction of the evening: our closest celestial neighbor, our partner

on our journey through the cosmos — the Moon. InOMN always has an annual theme, so a presentation in line with the theme would be particularly relevant.

This talk can stand alone, or immediately follow the introductory Overview. For ways to locate a speaker, use the resources found on

<http://observethemoonnight.org/getInvolved/connections.shtml>.

Hands-On Activities

Engage your participants by providing hands-on activities at your InOMN event (<http://observethemoonnight.org/activities/>). Alternatively, use some of the activities in this binder.

To further engage your audience in Moon viewing, provide Moon observation journals (<http://observethemoonnight.org/downloads/MoonObservationJournal.pdf>) and the Moon Map / Viewing Guide (<http://observethemoonnight.org/materials/>). These also can be saved as reference materials after InOMN.

Lunar Rocks and Meteorites

Are you, or a local educator, certified to borrow rocks or meteorites from the Moon? Take advantage! Lunar samples would be an excellent addition to an InOMN event. Make sure you request them well ahead of time, to ensure they will be available.

Tweet-up

To market your InOMN event to Twitter-savvy patrons, you can organize a Tweet-up. A special time set aside to talk with your lunar expert could be a great Tweet-up incentive, though feel free to be creative.

Refreshments

Food is always popular! — though whether you offer refreshments may depend on your budget. If you do provide food, an endless list of possible lunar goodies — cakes, cookies, cupcakes (and less-sugary options) — can easily incorporate the lunar theme! Don't forget the Moon Pies!

On a very serious note, make sure that water is available for your partners and audience. The amateur astronomers interacting with the public at the telescopes often will not have time for a break, and will not want to leave their telescopes unattended. Stage a cooler of water in the viewing area for them to easily access.

Activity: Craters Everywhere!

What You Are Going to Do

You and your family are going to make craters! This activity models how craters – the circular depressions on the Moon’s surface - form on the Moon and all other planets.

Careful! You and your family will be dropping and throwing marbles and pebbles into a pan; you will need to be careful to not hit anyone! This is a good “outside” activity.

How Long It Will Take

About 40 minutes from set up to clean up.

What You Need

- Pictures of the Moon (such as the Moon Map at <http://observethemoonnight.org/materials/>) and lunar craters
- A clear night with a good view of the Moon with at least ½ illuminated
- An impact box - a sturdy box at least 1’ x 1’ wide and 6” deep – a plastic dishpan or aluminum roasting pan will work well!
- Enough sand (or soil, or rice, or oatmeal) to fill the box to about 2” deep
- Flour to cover the sand to about a 1” depth
- Cocoa powder to cover the flour to about a 1/8” depth
- Several “asteroid” impactors of different sizes (like marbles, golf balls, or pebbles)

What to Do Ahead of Time

- Make the impact box by putting the layer of sand in first and smoothing the surface, covering the sand with the layer of flour and smoothing the surface, and covering the flour with a light dusting of cocoa powder.
- Review the “About the Moon” information so that you can be sure to be on your game to answer questions from your family.

What to Do With Your Family

- On a clear night, go outside and look at the Moon with your family. Ask them what features they observe just by looking at the Moon? Do they see

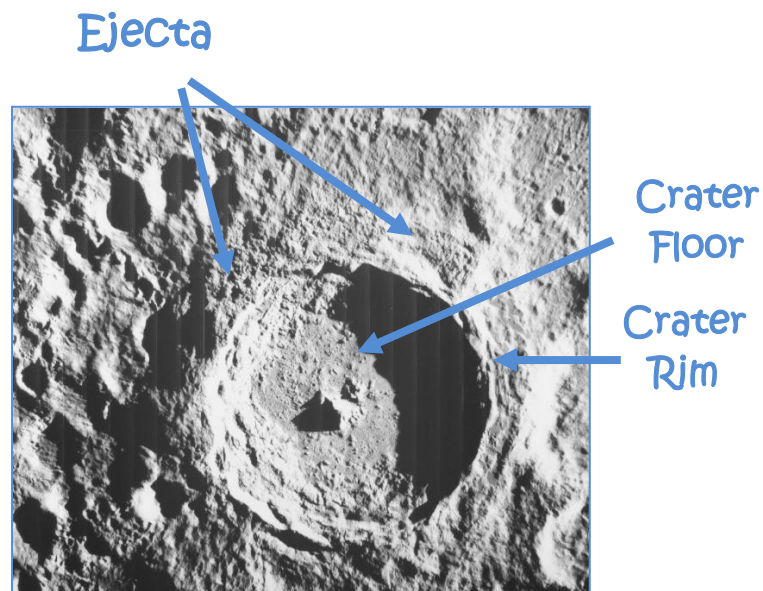
large, dark, round areas? Can they find smaller, bright, circular features? How might these features have formed?

- Show your family the image of the Moon and point out Tycho Crater and Copernicus Crater. These round, bright, bowl-shaped holes in the surface of the Moon are called “craters.” They have raised rims around them, and flat floors inside, and lots of material that is splattered around them (“ejecta”). Some of the craters have long, thin “rays” that extend long distances from the crater and make the crater look like a star burst.
- Invite your family to experiment with making craters by throwing or dropping an impactor into the box. *What do they observe? Can they identify different features of the crater (rays and ejecta and rims and floors? Do the features look anything like the round features they see on the Moon?*
- Experiment by dropping impactors from different heights and throwing them at different angles. Try impactors of different sizes. *Ask your family to make predictions—what will happen if they change the height? The size? Ask what they observe. How did these different experiments change the size or shape of the crater? The distance that the “ejecta” travel?*

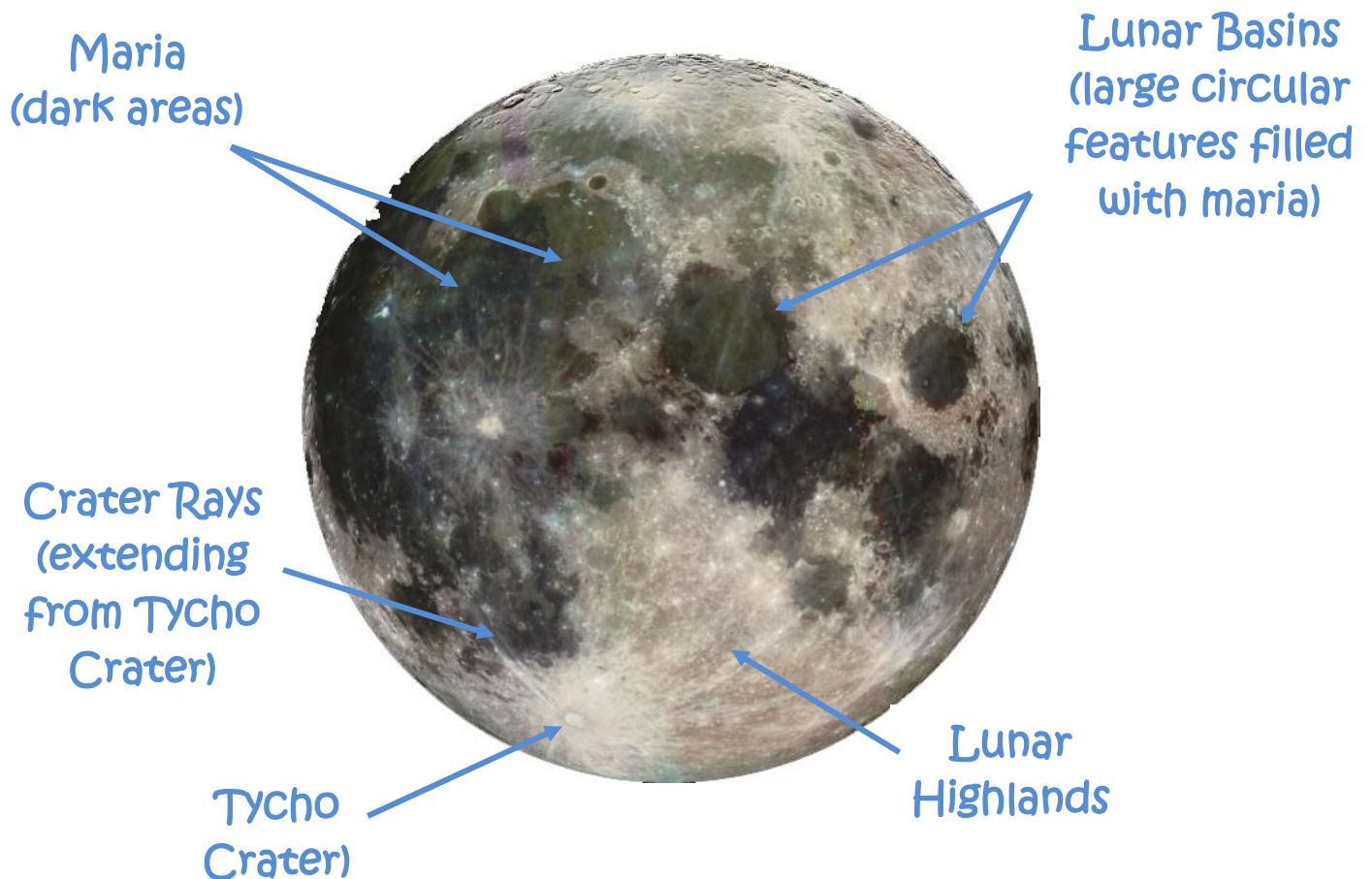
Wrapping Up

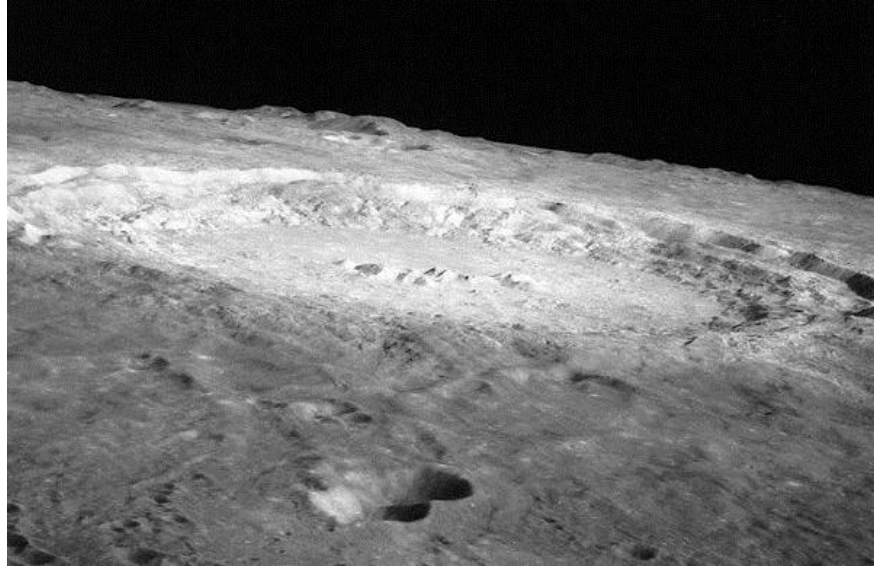
- Go back outside and look at the Moon, or look at the images of the Moon. *Ask your family what happened when they threw the impactors at the flour and cocoa in the box. Can the activity help explain some of the features that occur on the Moon?*
- *Can they use the observations to explain how the craters form on the Moon?* When objects like asteroids strike the Moon, they spew material onto the surrounding land. What remains is a crater, surrounded by a raised rim, and debris (“ejecta”). Sometimes the debris can be seen as long, bright “rays” radiating great distances from the crater. Tycho’s rays extend almost half way across the surface of the Moon!
- The larger and faster the impactor is, the larger the crater that results. The really, really big dark areas we can see with our eyes formed when really, really big asteroids hit the Moon!
- *What does your family observe about the number of craters on the Moon?* There are lots! Our Moon has been hit countless times, and each time a

crater is formed. Our Moon does not have wind or water to wear down the craters; once they form, they stay!

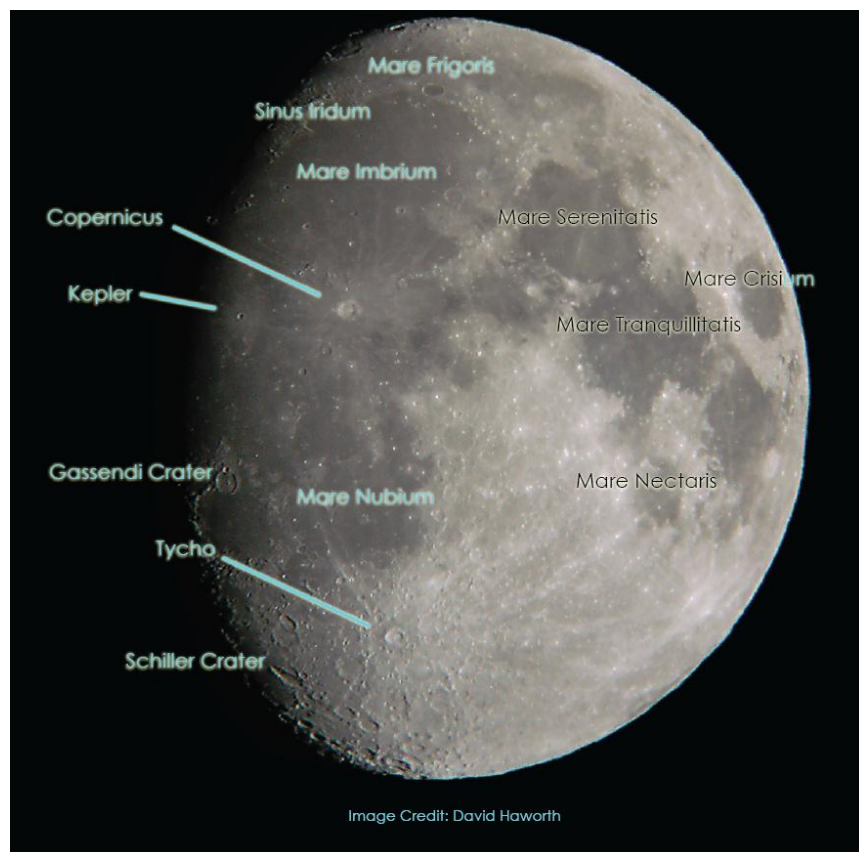


Typical Crater features found in Tycho Crater. Photo courtesy of NASA.





A view of Copernicus Crater taken from lunar orbit by Apollo 12. Photo courtesy of NASA.



A few highlighted features on the Moon's surface. Mare means "sea" in Latin (plural is "maria"). Early observers incorrectly thought the Moon had oceans, and named the individual "seas" they observed.

<http://observethemoonnight.org/materials/>

Activity: Edible Moon

What You Are Going to Do

You and your family are going to create models of the inside of the Moon ... and then eat them! The Moon, like Earth and most planets and moons we know, has layers inside. There is a small, but very dense core made mostly of iron, a middle rocky layer called the mantle, and an outer rocky crust.

How Long It Will Take

About 30 minutes from set up to clean up.

What You Need

For each Moon:

- ½ small marshmallow, or tootsie roll, or similarly sized candy (core)
- 1 Rice Krispies Treat (mantle)
- 2 tablespoons of icing (crust)
- 2 chocolate graham crackers and a teaspoon of powdered sugar (crust and lunar dust)
- Brown M&M's or similar dark chocolate candy
- Plastic baggie (sealable)
- 1 spoon
- 1 paper plate

What to Do Ahead of Time

- Review the information about the Moon's insides in "About the Moon" so that you can answer questions from your family and help them explore further.

What to Do With Your Family

- *Ask your family what is inside the Moon.* Someone probably will say "cheese!" Encourage them to think about what makes up our planets and moons in the solar system. Children ages 10 and older may know the Earth's layers and may be able to share "core," "mantle," and "crust." The exact names of the layers are not important, but you can share the idea that there are layers or differences inside planets and moons.

- Invite each family member to make a Moon!
- Open up the Rice Krispies Treat and place half of the small marshmallow or similarly sized candy (the Moon's small metallic core) in the middle of the treat.
- Gently wrap the Rice Krispies Treat around the marshmallow. The Rice Krispies Treat is the middle rocky layer, or mantle. Form the Rice Krispies Treat into a ball, rolling it around to make it more spherical.
- *Ask your family to compare the size of the mantle and core. Which is bigger – or has more “stuff?”* The mantle.
- Place the graham crackers and powdered sugar into the plastic bag. Press most of the air out and seal the bag. Have your family members crush the graham crackers with their hands or the spoon.
- Cover the Rice Krispies Treat with a thin layer of icing. This is the Moon's outer layer, the crust.
- Gently place the Rice Krispies Moon in the baggie of graham cracker crumbs and shake or roll it until it is covered with crumbs. This is the layer of lunar dust (regolith), formed by billions of years of asteroid and comet impacts breaking up the surface rocks on the Moon of the Moon.
- Invite your family to create craters in the crust using their fingers. Place an M&M or similar dark chocolate candy in some of the larger basins. This is the dark rock that you can see on the Moon from Earth that fills the basins on the Moon.

Wrapping Up

- Cut open your Moons to see the layers! *Ask your family to share what they know about the inside of the Moon.* Invite everyone to eat their “Moons!”

Activity: Moon Journal

What You Are Going to Do

The Moon is an easy object for young scientists to study. One of the best places to start is by making simple observations of the Moon on different days and noticing that the shape of the brightly lit portion as seen from Earth changes over time, and that there is a pattern to those changes. You and your family will observe the shape of the lit portion of the Moon over the course of four to five weeks and keep track of these observations in a Moon Journal.

Note: This is an appropriate activity for children ages 4 and up (adults welcome!); children will not be ready to understand the reason for phases until they are in their early teens.

How Long It Will Take

About 15 minutes to start, and about five minutes every evening (or every few nights) for the next five weeks.

What You Need

- Access to a location where you can consistently view the night sky.
- A Moon Journal either pre-formatted, such as <http://observethemoonnight.org/downloads/MoonObservationJournal.pdf>, or a booklet of blank pages for the family to note their Moon observations
- Colored pencils or markers, preferably one bright color like yellow or orange and one dark color like black or gray.

Note: An alternative, if you have wall space, is to draw and color nightly observations on paper plates, one plate per night. Hang these in order along a wall to see the patterns that emerge.

What to Do Ahead of Time

- Brush-up on the names and order of the Moon's phases in "About the Moon" so that you can answer questions from your family. Don't worry about the *reason* for phases for this activity.

What to Do With Your Family

- As a family, go outside and look at the Moon. *Ask what they observe about the shape of the part that is bright. How much is bright? What is the shape*

it has? Does the Moon's shape change? How? Is there a pattern to those changes?

- Invite your family to keep a Moon Journal to explore if and how the Moon's shape appears to change in the night sky.
- Help your family make their observations for this first viewing in their Moon Journal by coloring in the shape and portion that is bright with a bright pencil or marker. Shade the portion that is dark. Note the date and time of the observations.
- On each clear night – or every other night - go outside with your family and look at the Moon. *Has it changed since the last observation? If so, how?* Help them make their observations in their Moon Journal.
- *After several observations, ask your family how the Moon is changing—is it getting bigger (waxing) or smaller (waning)? Have they missed any viewing nights? What do they think the Moon's bright shape looked like on those missed nights?*
- After five weeks, examine what your family has observed. *Ask them if there is a pattern to how the shape of the Moon changes. How long does it take for the pattern to repeat?* Invite them to predict what they will see for their observations the following week.

Activity: Cookie Moon Phases

What You Are Going to Do

During a month, the part of the Moon that we see in the sky changes shape. It passes through different phases, growing from New Moon to Crescent to First Quarter to Gibbous to Full, and then the illuminated portion we see from Earth progressively shrinks until it is back to New Moon again. Each of these stages is a “phase.” In this activity, you and your family will learn about the Moon’s phases using cookies.

Note: This is an appropriate activity for children ages 4 and up (adults welcome!); children will not be ready to understand the reason for phases until they are in their early teens.

How Long It Will Take

About 30 minutes from set up to clean up.

What You Need

For every family member who participates:

- 4 round, cream-filled cookies like Oreos (use your favorite type!)
- 1 spoon or popsicle stick
- 1 Moon Phase Cookie Sheet
- Milk for dunking (optional)

For the whole family:

- Phrases for Phases song sheet

What to Do Ahead of Time

- Brush-up on the names and order of the Moon’s phases in “About the Moon” so that you can answer questions from your family. Don’t worry about the *reason* for phases for this activity.

What to Do With Your Family

- Ask your family if they have noticed that shape of the bright part of the Moon changes.










- Share that the Moon itself does not change shape – it is always a sphere, just like Earth! However, the amount of the Moon that is made bright by sunlight *that we see from Earth* changes.
- Share that there is a pattern to the changes and that different shapes have different names.
- Invite your family to make the shapes of the brightly lit part of the Moon that we see from Earth using cookies and the cream inside.
- Have them carefully twist open the cookies and reshape the cream inside so that it looks like the pictures on the Moon Phase Cookie Sheet. Challenge them to use just 4 cookies total! One cookie can be used to make the New Moon (no cream) with one side and the Full Moon with the other side. Prompt them to place their cookie Moons over the same Moon on the Moon Phase Cookie Sheet.
- As they are making the phases, point out the names of the phases. *Why is the name “crescent” used?* Because it looks like a crescent! “Gibbous” means “humpback,” which is sort of the shape of the Gibbous Moon. Waxing means “to increase gradually in size,” while waning means “to get smaller.”
- *What happens after the Moon reaches the Waning Crescent stage? Is it finished with phases?* No! The pattern of phases starts over and repeats again and again! The whole cycle of phases takes about a month – or moonth (which is where the word “month” comes from)!
- For younger children, the main point is that the shape of the brightly lit part of the Moon that we see from Earth changes shape and there is a repetitive pattern to the changes. Do not worry if they don’t recall the names of the phases!
- When your family is finished making all of the phases, sing the Phrases for Phases song together. Have your family point to the phase as they sing about it.

Wrapping Up

- *What phase is the Moon in tonight?* If it is a clear night, go outside to look at the Moon. *Is there a cookie phase that matches?*
- Enjoy the cookies!

Moon Phase Cookie Sheet

Can you make the Moon Phases?

 <p>New Moon No (or almost no) light area.</p>	 <p>Waxing Crescent A small sliver of light on the right.</p>	 <p>First Quarter Moon The right half of the Moon is light.</p>
 <p>Waxing Gibbous Three quarters of the right side of the Moon is light.</p>	 <p>Full Moon The entire Moon is light.</p>	 <p>Waning Gibbous Three quarters of the left side of the Moon is light.</p>
 <p>Third Quarter Moon The <i>left</i> half of the Moon is now light.</p>	 <p>Waning Crescent A small sliver of light now appears on the <i>left</i> side.</p>	

Modified from Paper Plate Education

(<http://analyzer.depaul.edu/paperplate/Oreo%20Moon%20Phases.htm>)

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Phrases for Phases Song

Lyrics by Becky Nelson, The Lunar and Planetary Institute

Sung to the tune The Ants Go Marching . . Moon phases and important terms are in capital letters.

Each Moon phase marches COUNTERCLOCKWISE —

Now, let's start . . .

The FIRST PHASE is the NEW MOON that we see as DARK.

Then next the WAXING CRESCENT shines

A LITTLE LIGHT upon the RIGHT,

And after that's the

QUARTER MOON, where the
RIGHT HALF'S LIGHT.

Waxing Crescent



Waxing Gibbous



Waning Gibbous



Waning Crescent



Following is WAXING GIBBOUS on the RIGHT,

Where the LIGHT continues SPREADING and becoming bright.

We'll be HALFWAY through the phases soon,

With the FULLEST, brightest, biggest MOON,

Just before the DARK creeps

On the RIGHT

Of a WANING MOON.

The WANING GIBBOUS phase is when the LIGHT will SHRINK,
Then what will be the next phase after that, you think?

It's once AGAIN a QUARTER MOON,

But the DARK HALF's now upon the RIGHT,

And the LEFT side is the

One's that's BRIGHT!!

Did you get that right?

The next phase is the LAST phase where there's just a spark
Of light, so WANING CRESCENT appears ALMOST DARK!

The Moon is really magical,

When it's WAXING, WANING, NEW OR FULL.

And it COULDN'T SHINE at all

WITHOUT.....

THE SUN'S.....bright light!!

Activity: Fruit for Phases

What You Are Going to Do

You and your family will explore lunar phases to learn how the relative positions of our Moon, Earth, and Sun cause the phases of the Moon as viewed from Earth.

Note: This is an appropriate activity for children in their early teens and up. Younger children will not be ready to understand the reason for phases, but can learn about the pattern to the phases using the other activities in this set.

This is a great activity to follow Moon Journal and Cookie Moon Phases

How Long It Will Take

About 30 minutes from set up to clean up.

What You Need

- A cantaloupe or grapefruit or similarly sized smooth light-colored ball
- A table lamp with a bright bulb or strong flashlight
- A room large enough for the family to stand in a circle about 10 feet across (3 meters) that can be darkened

What to Do Ahead of Time

- Remove the shade from the lamp and position the lamp on a table or sturdy boxes in one corner of the room so that the bulb is about shoulder level for the children in the family. Have the light turned off at the start.
- Review the reason for the changing phases of the Moon in “About the Moon” so that you can answer questions from your family.

What to Do With Your Family

- Ask your family if they have noticed that shape of the bright part of the Moon changes. If they have completed the Moon Journal or the Cookie Moon Phases activities, ask them to share what they remember.
- Share that the Moon itself does not change shape – it is always a sphere, just like Earth! However, the amount of the Moon that is made bright by sunlight *that we see from Earth* changes.

- Invite your family to share what they think about why there are phases of the Moon. *Why does the phase of the Moon change? Is there a pattern to the changes? How long does it take for the pattern to repeat?* If some members know the right answer, ask them to keep it to themselves until everyone has had a chance to play with the activity.
- Provide one family member with the piece of fruit. This represents the Moon. The head of the person holding the fruit is the Earth (perhaps his/her nose is Mt. Everest?).
- *Ask if the fruit makes its own light – or shines.* It certainly doesn't! *Ask if the Moon make its own light.* Nope! Planets and moons do not shine. *What, then, causes the Moon to be so bright? What is the source of light in our solar system?* Our Sun! The Moon – and all planets and moons in our solar system – get light from the Sun. The bright part of the Moon is what we see reflecting the Sun's light.
- Turn on the table lamp in the corner and turn off the other lights in the room. *What does the table lamp represent in our solar system?* The Sun!
- Invite the person holding the fruit to stand about 3 feet (1 meter) from the lamp – with their back to the lamp - and hold the fruit at arm's length in front of them just a little above their head. Invite the rest of the family to stand in a circle around the "Earth."
- *Ask your family what they observe. Is the entire fruit bright? Just part? Which part is bright?* The half that is facing the lamp is bright; it is reflecting the lamp's light.
- *Ask the person holding the fruit what phase they would see from Earth.* The entire side of the Moon facing Earth is bright. This is the Full Moon. Have other family members confirm this – they will need to move around to see the Moon from the Earth's perspective.
- Now have the person holding the fruit swing around 180 degrees counterclockwise so that the fruit is held at arm's length between the lamp and the "Earth" but held just a little above the "Earth's" head. *Now which part of the fruit is bright?* The half that is facing the lamp is bright. *But what is seen from Earth? Is any of the bright / lit side seen?* No. *What phase is this as seen from Earth?* This is the New Moon. Have other family members confirm this – they will need to move around to see the Moon from the Earth's perspective.

- Have the family member holding the fruit continue to turn counterclockwise, about 90 degrees, so that the fruit is now held at arm's length in a position between New Moon and Full Moon. *Ask your family members which part of the fruit is bright?* It is still the half that is facing the lamp! *But what is seen from Earth? Is any of the bright / lit side seen?* Yes, half of the side facing Earth is bright. This is the First Quarter phase. Have other family members confirm this – they will need to move around to see the Moon from the Earth's perspective.
- Pause and help your family reflect on what they are observing.
 - *What did family members who were not on Earth observe about how much of the Moon's surface is always bright or lit by the Sun?* They saw that half - the half facing the Sun – was always bright. If you were standing above Earth and looking down at the Earth-Moon-Sun system, you would not see any phases!
 - *Does the Moon make its own light?* No! *What causes it to be so bright?* It reflects the Sun's light.
 - *But what about Earth's perspective? What caused phases?* The changing / different positions of the Earth, Moon, and Sun, relative to each other, created the phases of the Moon we observe on Earth.
 - Can your family remember the other phases they have seen or observed in the activities? How long did it take to go through the cycle of phases, from Full Moon back to Full Moon? About a month.
- Invite each family member to take a turn being the Earth and holding the Moon. Have each “take a spin” at making the eight different phases in order by making the fruit Moon orbit their Earth in a clockwise direction. Can they name the phases as they create them?
- Invite other family members to observe how the half of the Moon facing the Sun always stays bright, and to help name the phases that Earth is seeing.

Wrapping Up

- *What phase is the Moon in tonight?* If it is a clear night, go outside to look at the Moon. Invite your family to use the fruit Moon and lamp Sun to recreate the current phase of the Moon.

Activity: What Do You See in the Moon?

What You Are Going to Do

The shapes observed on the surface of our Moon have inspired many beautiful stories in different cultures past and present. The stories about how the Moon formed or changed, or how the feature got there involve rabbits, dogs, crabs, frogs, men, women, gods and goddesses, and more!

In this activity, you and your family will use your imaginations to identify an object or character in the Moon and create a story about it.

How Long It Will Take

About 30 minutes from set up to clean up.

What You Need

- A clear night with a good view of the Moon with at least $\frac{3}{4}$ illuminated

For Your family:

- Books that share stories from different cultures about the Moon. Visit your local library or search the Internet for books and collections like these:

Moontellers: Myths of the Moon from Around the World
Lynn Moroney, 1995, Northland Publishing Company, ISBN
0873586018

Dot to Dot in the Sky: Stories of the Moon
Joan Marie Galat, Whitecap Books, 2004, ISBN 1552856100

MyMoon: World Tales of the Moon
(<http://www.lpi.usra.edu/mymoon/?p=tales/>)

This site offers links to several stories from across the globe, including "Rabbit on the Moon" (Mexico), "Drummer on the Moon" (Ivory Coast), "Tears on the Moon" (Algeria), "Rabbit and Frog on the Moon" (China), and "Boy on the Moon" (North America).

For each story about the Moon:

- Image of the Moon, such as “What I See in the Moon”
- Crayons, markers, or colored pencils
- Extra paper for illustrating stories or story writing

What to Do With Your Family

- As a family, go outside and look at the Moon, or look at the images of the Moon.
- *Ask what they see when they look at the Moon. They may say “dark circles” and “light areas.” Ask if they can see any figures or characters made up by the features on the Moon. Ask if they have heard any stories about the man or rabbit in the Moon.*
- Together, read a story about the Moon from a different culture. When you are finished, discuss the story. *Did they like the story? What parts did they like the most? The least? Why?*
- *Ask who wants to create their own story about the Moon.* Give at least one “What I See in the Moon” sheet and crayons or markers or colored pencils to everyone who wants to make up a story.
- *Invite them to color the character or person or object they see in the Moon on their sheet. Do they see a boat? A house? A flower? Cat? Horse? Person? A dragon or dinosaur? Have them share the story of how that object got onto the Moon or why it is there.* Stories often start with “A long time ago ...”
- Enjoy the stories together!

What I See in the Moon



A long time ago ... _____

Connect!

Find a Local Astronomical Club or Other Viewing Partners

Find out about Moon viewings – or other fun lunar science and exploration events - going on in your neighborhood.

Visit the International Observe the Moon Night website to share your InOMN event, or discover other InOMN events near you.

<http://observethemoonnight.org/>



Use one of these search sites to get in touch with your local astronomical society or club:

Astronomical Society of the Pacific

<http://www.astrosociety.org/resources/linkclubs.html>

Sky and Telescope

<http://www.skyandtelescope.com/community/organizations>

Night Sky Network

<http://nightsky.jpl.nasa.gov/club-map.cfm>

Finally, check out the programs that are offered by your local library, museum, science center, or planetarium. *Can't find anything about the Moon?* Suggest that they consider some future programming and encourage them to contact the InOMN organizers for lots of different programming ideas (not just about InOMN!)

<http://observethemoonnight.org/>.

Visit Your Library

Check Out the Abundance of Book and Media Resources Available and
Look for a Few of These!

The Best Book of the Moon

Ian Graham, Kingfisher, 2005, ISBN 0753459027

This book introduces the Moon's formation and evolution, surface features, exploration, and lunar cycles and Earth's tides. The fantastic illustrations include Moon maps and Moon-watching tips. Appropriate for children ages 4 to 8.

How the Moon Regained Her Shape

Janet Heller, Sylvan Dell, 2007, ISBN 1934359025

The author uses a native American folk myth to teach children 4 to 8 about the moon's phases and encourage children's self-esteem. There is also an end section of science ideas.

Jump Into Science: Moon

Steve Tomecek, National Geographic Children's Books, 2005, ISBN 0792251237

Children go on a journey with a bug and a cat to discover the Moon's scientific history and concepts. This is a great book for ages 4–8.

Faces of the Moon

Bob Crelin, Charlesbridge, 2009, ISBN 9781570917851

A great way to help children ages 4 to 8 learn about the phases of the Moon! Cut-outs in the pages help illustrate that phases are merely the result of light and shadow.

Tell Me Why the Moon Changes Shape

Shirley Willis, Children's Press, 2000, ISBN 0531159809

This fun exploration of the Moon answers questions like "Is the Moon Made of Cheese?" for children ages 4 to 8. The Moon's age, size, phases, and exploration are also discussed.

When the Moon is Full: A Lunar Year

Penny Pollock, 2001, Little, Brown Young Readers, ISBN 0316713171

Beautiful prints accompany this collection of Moon poems. Includes a question-and-answer page with facts about the Moon. Appropriate for ages 4 to 8.

Moontellers: Myths of the Moon from Around the World

Lynn Moroney, Northland Publishing, 1995, ISBN 0873586018

The author provides twelve different interpretations of images that can be seen on the surface of the Moon. This book is great for ages 4 and up!

The Moon

Seymour Simon, Simon & Schuster Children's Publishing, 2003, ISBN 0689835639

A general overview of the Moon and lunar exploration with fantastic images for children ages 7 to 10.

Exploring the Moon

Rebecca Olien, PowerKids Press, 2007, ISBN 1404234667

The Moon's beginning, layers, surface features, phases, eclipses, and exploration are explained in this easy-to-read book for 8 to 9 year olds. Images to illustrate the author's topic accompany the text.

Day and Night

Graham Dolan, Heinemann Library, 2001, ISBN 1588100421

Children ages 8 to 12 explore the concept of time from the perspective astronomy, with discussions of day and night and phases accompanied by superb diagrams.

Tales of the Shimmering Sky: Ten Global Folktales with Activities

Susan Milord, Williamson Publishing, 1996, ISBN 1885593015

Two chapters address the influence of the Moon on world culture through illustrations, engaging stories, science facts, and activities. Children ages 8 to 12 may read a tale from India about the hare seen in the face of the full Moon or a Jewish story about the lunar cycle.

The Moon

Elaine Landau, Children's Press, 2008, ISBN 0531125629

Readers age 9 to 12 can delve into many *Explore! Marvel Moon* topics: the Moon's formation; interior; surface features; exploration; phases; myths; and relationship to Earth's tides. Images support the text.

The Moon: Earth's Neighbor

David Jefferis, Crabtree Publishing Company, 2008, ISBN 0778737470

Written in a question-and-answer format, readers ages 9 to 12 will gather some unique facts from this overview of the Moon. Includes diagrams about Earth's and the Moon's relative sizes and distance, an explanation of tides, and tips on photographing and observing the Moon.

The Moon: Earth's Companion in Space

Michael D. Cole, 2001, Enslow Publishers, ISBN: 0766015106

Children ages 9 to 12 learn about the Moon's features and structure; lunar orbits and phases; human exploration; and Earth's tides. Includes a chapter on observing the Moon.

Moon and Tides

Rob Lang, Creative Teaching Press Inc., 2009, ISBN 1591987083

After providing basic information about the Moon, the author discusses eclipses, gravity, and tides. Appropriate for children ages 9 to 12.

Why Does the Moon Change Its Shape?

Patricia J. Murphy, Rosen Classroom, 2005, ISBN 1404255931

Images accompany text about the Moon's formation, interior, phases, exploration and Earth's tides. For children ages 9 to 12.

Earth and the Moon

Rebecca Stefoff, Benchmark Books, 2001, ISBN 0761412352

Easy-to-read text provides children ages 9 to 12 with an in-depth look at many of the concepts in *Explore! Marvel Moon*: the Moon's formation; interior; surface features; exploration; and the cycles of day and night, seasons, months, and tides. The author briefly considers, "What If the Moon Didn't Exist?" Images and diagrams support the text.

Dot to Dot in the Sky: Stories of the Moon

Joan Marie Galat, Whitecap Books, 2004, ISBN 1552856100

The author shares with children age 9 to 12 stories about the Moon from other cultures. Moon facts, including information about geology, tides, Moon phases, eclipses, are listed with each story presented.

Earth and Moon

Brian Knapp, Grolier, 2004, ISBN 0717258289

This book is a rich resource for children ages 9+ for general information about the Moon and Earth, as well as their orbits and seasons, tides, gravity, and lunar phases. It offers a unique section about lunar soil and rocks. Images and diagrams support clear explanations.

The Kids Book of the Night Sky

Ann Love and Jane Drake, Kids Can Press, 2004, ISBN 1553371283

Sky maps, myths, games, and kid-friendly activities connect children, ages 8 to 13, to the stars, Moon, and planets. It includes a humorous, comic-strip-style description of the Moon's formation.

A Child's Introduction to the Night Sky: The Story of the Stars, Planets and Constellations — and How You Can Find Them in the Sky

Michael Driscoll, Black Dog & Leventhal Publishers, Inc., 2004, ISBN 157912366X

This guide is for star-gazers and planet watchers aged 8–13. The author provides an illustrated overview of planets and the constellations. A section about astronauts and astronomers, including the tools they use and a few featured scientists, is included.

The Modern Moon: A Personal View

Charles Wood, 2003, Sky Publishing Corporation, ISBN: 0933346999

The perfect companion to lunar telescope viewing. Wood works his way across the lunar surface, identifying features of scientific importance and the people involved in unraveling their story. Appropriate for the facilitator and ages 9 and up.

Moon Observer's Guide

Peter Grego, 2004, Firefly Books, ISBN 1552978885

Offers advice for viewing the Moon with the naked eye, binoculars, and telescopes and explains the causes of surface features. This book guides readers through 28 days of observing! Appropriate for the facilitator and ages 9 and up.

The Solar System and the Stars

Claude Lafleur, World Almanac Library, 2001, ISBN 0836850041

This book is packed with introductions to many space science topics for ages 9–12. It offers a unique, illustrated description of the formation of the Sun, Earth, and Moon. Pictures of Moon rocks — an example of each the three main types (anorthosite, basalt, and breccia) — and topography support the ongoing story of the Moon. Lunar phases and Earth's seasons are also clearly explained.

Exploring Our Solar System

Sally Ride and Tam O'Shaughnessy, Crown Books for Young Readers, 2003, ISBN 0375812040

This well-illustrated book takes children ages 9–12 on a tour of the planets (and our Sun!) in our solar system. In addition to clear explanations of lunar phases and Earth's seasons and tides, this book includes a timeline of major events in the history of our planet.

The Moon Watcher's Companion: Everything You Ever Wanted to Know about the Moon and More

Donna Henes, Marlowe & Company, 2004, ISBN 1569244669

This collection of poems, myths, folktales, and facts demonstrates the influence of the Moon on world culture. Each lunar phase is explored separately. Children ages 12+ may especially enjoy the "Lunar Riddles," "Lunar Bestiary," and "Encyclopedia of Lunar Terminology."

The Grand Tour: A Traveler's Guide to the Solar System

Ron Miller and William K. Hartmann, Workman Publishing Company, 2005, ISBN 0761139095

Older children and adults can tour our solar system without ever having to leave the comfort of Earth! The section on Earth's Moon is a rich resource of information and illustrations (including a series about the Moon's formation).

Earth and the Moon

Ron Miller, 2003, Twenty First Century Books, ISBN: 0761323589

Written for young teens, this book examines the history of the Earth and Moon, including their formation. Earth's interior, seasons, and tides, as well as lunar phases and exploration, are explored.

The Earth and the Moon

Linda Elkins-Tanton, Chelsea House, 2006, ISBN 0816051941

Written for young adults and adults, this book discusses Earth's size, orbit, mass, seasons and more as well as the evolution of the Moon.

Explore Further Online

A Selection of Web Sites to Help You Immerse Yourself in the Moon

The Moon for Young Scientists

Windows to the Universe

http://www.windows.ucar.edu/tour/link=/earth/moons_and_rings.html

Windows to the Universe shares our Moon's formation, what makes the light and dark areas on the Moon, and more! The information is presented at three levels, for ages 8 and older.

Enchanted Learning's Zoo Astronomy – the Moon!

<http://www.allaboutspace.com/subjects/astronomy/Moon/>

Enchanted Learning's Zoo Astronomy website provides information and fun facts for kids of all ages. Get a basic overview of different aspects of the Moon including its orbit, size, temperature and lots more! There are also coloring pages, puzzles, and quizzes for children to enjoy. Covers a broad range of children's activities and information from ages 5–12.

Other Moon Sites to Explore

Lunar Surface Flyovers

http://www.lpi.usra.edu/lunar/lunar_flyovers/

Fly over the dramatic terrain of the lunar surface in this series of digital movies.

Sky & Telescope

http://www.skyandtelescope.com/letsgo/whatsuptonight/Month_of_Moonwatching.html?page=1&c=y

Sky & Telescope gives young adults and adults the opportunity to take a Moon walk. Discover the different features of the Moon that are visible during different phases. A map of the Moon is provided to help guide the way. A good starter to help parents engage younger children in observing the Moon.

What if the Moon did not exist?

<http://365daysofastronomy.org/2009/03/28/march-28th/>

This March 28, 2009 podcast from 365 Days of Astronomy Podcast, explores the question, "what if the Moon did not exist?" The influence of the Moon on our length of the day, Earth's tilt, and cultural references are explored. Suitable for a general audience.

MyMoon

<http://www.lpi.usra.edu/mymoon/>

Not your typical NASA site about the Moon! This site invites 18-25 year olds (or those who are 18-25 at heart) to experience the Moon through science, art, literature, and pop-culture, and,

more importantly, to share their own experiences and observations about the Moon and lunar exploration. Quirky exhibits, contests, polls, and conversations can be found here.

Connect to the Moon

<http://www.lpi.usra.edu/education/lprp/>

Paths for inquisitive adults, students, and formal and informal educators to find online resources, information, and opportunities for involvement in lunar science and exploration.

Google Moon

<http://www.google.com/moon/>

Moon in Google Earth

<http://earth.google.com/moon/>

Inconstant Moon

<http://www.inconstantmoon.com/>

Pictures, calendars, and music that can be enjoyed by all ages.

Get Involved!

International Observe the Moon Night (InOMN)

<http://observethemoonnight.org/>

The International Observe the Moon Night (InOMN) is a world-wide celebration of our nearest neighbor, the Moon! Each year in the fall, millions of people from hundreds of locations in countries across the globe come together to view the Moon and learn about its diverse roles in culture, history, science, and exploration. Learn more! Host an event! Participate in an event!

Moon Zoo

<http://www.moonzoo.org/>

Participate in lunar science through this online citizen science project. Moon Zoo uses about 70,000 high resolution images gathered by the Lunar Reconnaissance Orbiter. Citizen scientists are invited to categorize craters, boulders and more, including lava channels and even all sorts of different spacecraft sitting on the Moon's surface.

NASA and the Moon (for Young Adults & Adults)

NASA Lunar Science Institute

<http://lunarscience.arc.nasa.gov/>

Adults may learn about news and events relating to the Moon and lunar science, browse through the "Ask a Lunar Scientist" section, and access education and multimedia resources. Kids can learn about the Moon's characteristics, surface features, appearance, and future exploration in the "Lunar Science for Kids" section.

Center for Lunar Science and Exploration

<http://www.lpi.usra.edu/nlsi/index.shtml>

The Lunar and Planetary Institute offers a wealth of lunar resources – from past missions right up to the present cutting-edge lunar science and exploration. This NASA Lunar Science Institute (NLSI) site has an abundance of existing lunar images, data, and studies.

Lunar and Planetary Website

<http://nssdc.gsfc.nasa.gov/planetary/planets/moonpage.html>

website offers information ranging from Moon Fact Sheets to Past and Future Missions. There are also on-line books that can aid in further understanding of the numerous missions to the Moon.

Exploration Systems Missions Directorate

<http://www.nasa.gov/exploration/home/index.html>

NASA's Exploration Systems Missions Directorate is responsible for the engineering and technology required to support human and robotic exploration of the Moon and beyond.

Scientific Context for Exploration of the Moon

http://www.nap.edu/catalog.php?record_id=11954

Why go back? There is great science still to be done – not to mention preparing to go farther in our solar system! The Committee on the Scientific Context for Exploration of the Moon (National Research Council) authored this report on the current understanding of the early Earth and Moon. They identified key science concepts and goals for Moon exploration, provided an assessment of implementation options; and laid out a set of prioritized lunar science concepts, goals, and recommendations.

Some Selected Lunar Missions (for Young Adults & Adults)

The Lunar Reconnaissance Orbiter Site – LRO

<http://lunar.gsfc.nasa.gov/>

NASA's Goddard Space Flight Center offers a brief mission overview for the Lunar Reconnaissance Orbiter as well as a timeline, details about the instruments on the LRO, and images of the LRO. Explore the Outreach pages for links to more activities and resources.

The Lunar Crater Observation and Sensing Satellite – LCROSS

<http://lcross.arc.nasa.gov/>

NASA's Ames Research Center offers a brief mission overview for the Lunar Crater Observation and Sensing Satellite (LCROSS) as well as a timeline and multimedia including images, videos, and the song "Water on the Moon." Additional activities can be accessed through the Education page, and learn about observing the impact event through the Observations page.

Gravity Recovery and Interior Laboratory - GRAIL

<http://moon.mit.edu/>

GRAIL will fly twin spacecraft in tandem orbits around the Moon for several months to measure its gravity field in unprecedented detail. The mission will provide scientists a better understanding of how Earth and other rocky planets in the solar system formed.

Apollo Program

<http://www.hq.nasa.gov/office/pao/History/SP-350/toc.html>

<http://www.lpi.usra.edu/lunar/missions/apollo/>

<http://www.nasm.si.edu/collections/imagery/apollo/apollo.htm>

Apollo Surface Panoramas

<http://www.lpi.usra.edu/resources/apollopanoramas/>

Apollo Surface Panoramas is a digital library of photographic panoramas that the Apollo astronauts took while exploring the Moon's surface. These images provide a spectacular boots-on-the-ground view of the lunar landscape.

Kaguya

http://www.kaguya.jaxa.jp/index_e.htm

Stunning images have been returned by The Japan Aerospace Exploration Agency's (JAXA) Kaguya mission, which orbited the Moon from September 2007 to June 2009. The mission undertook global mapping of the lunar surface and gathered magnetic and gravity field measurements.

Lunar Exploration

http://nssdc.gsfc.nasa.gov/planetary/lunar/apollo_25th.html

NASA's Planetary Web site lists the Lunar Missions in chronological order. Each mission provides information on the type of spacecraft used as well as what it discovered. Pictures taken by the spacecraft are also included.

And Finally, Yes, We Really *Did* Go To The Moon ...

Mythbusters Results

<http://mythbustersresults.com/nasa-moon-landing>

Mythbusters Episode 104: NASA Moon Landing. Appropriate for ages 12 and up.

Phil Plait's Bad Astronomy

<http://www.badastronomy.com/bad/misc/apollohoax.html>

Yes, We Really *Did* Go to the Moon! Appropriate adults.

NASA's The Great Moon Hoax

http://science.nasa.gov/science-news/science-at-nasa/2001/ast23feb_2/

Appropriate for adults.



<http://observethemoonnight.org/>

